CHAPTER 6

SEWER PIPE MATERIALS, FITTINGS, AND JOINTS

6-1. General. Factors which will be considered in the selection of sewer pipe materials and piping systems are:

- Availability of pipe in required sizes, strengths, etc.
- Availability of fittings, connections, and adapters.
- Ease of handling and installation.
- Physical strength.
- Flow characteristics or friction coefficient.
- Joint watertightness and ease of installation.
- Resistance to acids, alkalis, high temperature or corrosive wastes, and corrosive soils.

No pipe manufactured is suitable for all sewer installation requirements and conditions. The pipe materials covered in this chapter are the ones most often used for sanitary and industrial waste sewers. Each type of pipe will be evaluated to determine its suitability for the particular design. Where iron or concrete pipe are to be considered, special attention will be paid to subsurface and soil conditions. The characteristics of the soil in which a pipe is placed affect the rates of corrosion, with the most corrosive soils being those having poor aeration and high values of acidity, electrical conductivity, dissolved salts, and moisture content. The relative potential for corrosion may be estimated by evaluating the degree of corrosion of existing metallic or concrete pipelines previously buried in the soil. Facility engineer personnel will normally have knowledge of these matters. When this information is not available, or is nonconclusive, resistivity tests of the soil will be conducted and results evaluated as required. Pipe materials found inappropriate for use will be deleted from the project specifications.

6-2. Ductile iron.

a. Ductile iron (DI) pipe is utilized for sewers requiring a high resistance to external loading, a high degree of toughness and ductility. It is well suited for most sanitary sewers including river crossings, piping at wastewater treatment facilities, pipe located in unstable soils, highway and rail crossings, water line crossings, depressed sewers and piping aboveground. However, the use of DI pipe is limited somewhat by a susceptibility to corrosion from wastewaters containing acids, and from aggressive soils. DI pipe will normally be

cement lined and can be provided with a bituminous coating inside or a polyethylene lining. Exterior bituminous coatings are standard, and where soil is extremely corrosive, a polyethylene encasement may be required.

b. Pipe is available in diameters 3-inch through 54-inch, and in 18 or 20 foot laying lengths. Allowable trench and superimposed surface loads for DI pipe are computed and tabulated in ANSI A21.50. The ordinary range of loadings can be met without special bedding materials and procedures. The DIPRA Handbook of Ductile Iron Pipe Cast Iron Pipe will be referenced for guidance in designing and installing ductile iron pipe.

6-3. Cast iron soil.

a. Cast iron soil (CIS) pipe will normally be allowed only as an option for buiding connections. CIS pipe is used primarily for building interior drainage, waste and vent piping, as described in chapter 1 of the CISPI Cast Iron Soil Pipe & Fittings Handbook. CIS pipe is resistant to internal and external corrosion when provided with a bituminous coating and is not subject to abrasion from grit, sand, or gravel.

b. CIS pipe is available in 2-inch through 15-inch diameters, in 5 and 10 foot laying lengths, and is manufactured in service (SV) and extra heavy (XH) classifications. Pipe joints will be either compression type using rubber gaskets, or bell and spigot type calked with lead and oakum. Structural design of CIS pipe will be in accordance with the methods outlined in chapter 5 of the CISPI Cast Iron Soil Pipe & Fittings Handbook, with special emphasis given to external loadings and pipe strength.

6-4. Vitrified clay.

a. Vitrified clay (VC) pipe is manufactured from clay and shale products to form an ideal material for sewer use. VC pipe has a high resistance to corrosion from acids and alkalies and resists scouring and erosion well. This provides a distinct advantage in serving as industrial waste sewers, or sanitary sewers subject to hydrogen sulfide generation. It should be noted that availability of some sizes and strength classifications is limited in certain geographical areas. VC pipe is also known for brittleness.

b. VC pipe is available in nominal diameters 4-inch through 42-inch, and laying lengths of 1 to 10 feet. VC pipe is manufactured in standard and extra strength classifications. The NCPI Clay Pipe Engineering Manual provides engineering data to be used in designing clay pipe sewers.

6-5. Concrete.

a. Concrete sewer pipe is appropriate for applications requiring large diameter sizes or high strength characteristics. Care should be taken when specifying concrete pipe to assure that it is suitable for the environment in which it will be installed. Type II A cement, as specified in ASTM C 150, is sufficient for most installations. Type I may be used in certain situations where less than 0.1 percent soluble sulfates (SO_4) occur in the soil, or the wastewater contains less than 150 mg/l sulfates. If the soil contains more than 0.2 percent water soluble sulfates, or the wastewater sulfate concentration exceeds 100 mg/l, Type V cement will be required. Unlined concrete pipe is subject to scouring by wastewaters carrying grit and sand at high velocities.

b. Reinforced concrete (RC) pipe will be used where high external loadings are anticipated and large diameters or tight joints are required. The advantages of RC pipe include a wide range of diameters, 12-inch through 108-inch, and laying lengths, 4 feet to 24 feet, which are available. A disadvantage is the lack of corrosion resistance to acids, especially critical where hydrogen sulfide is generated in substantial quantities. However, special PVC or clay liner plates, coatings of coal-tar, coal-tar epoxy, vinyl, or epoxy mortar can be applied to the pipe for corrosion protection. Nonreinforced concrete sewer pipe is generally available in diameters 4-inch through 30-inch, and in minimum laying lengths of 3 feet. Concrete pipe joints are either bell and spigot type using O-ring gaskets, or tongue and groove type made with cement mortar or bituminous mastic. Design of concrete sewers will be in accordance with the ACPA Concrete Pipe Handbook.

6-6. Asbestos-cement.

a. Asbestos-cement (AC) pipe is made from a mixture of asbestos fibers and portland cement. AC pipe matches the durability of concrete pipe but weighs less and is manufactured in a wide variety of strength classifications and laying lengths. AC pipe will deteriorate in a corrosive environment of hydrogen sulfide, acid wastes or aggressive soils; however some degree of protection can be provided with plastic linings. AC pipe material allowed for sewers will be limited to Type II as recommended in ASTM C 500.

b. For gravity sewers 8-inch in diameter and above, AC pipe is manufactured in five strength classifications conforming to ASTM C 428, namely, Class 1500, 2400, 3300, 4000, and 5000. The class designation refers to the minimum three-edge bearing test strength in pounds per lineal foot of pipe. Classes 1500, 2400, and 3300 are generally available in diameters 8-inch through a maximum of 30-inch, and Classes 4000 and 5000 in diameters 10-inch through 42-inch. Laying lengths normally are 10 and 13 feet. Joints are made with couplings employing rubber ring gaskets.

6-7. Polyvinyl chloride plastic.

a. Polyvinyl chloride (PVC) pipe is chemically inert to most acidic and alkaline wastes, and is totally resistant to biological attack. Since it is a nonconductor, PVC pipe is immune to nearly all types of underground corrosion caused by galvanic or electrochemical reactions, in addition to aggressive soils. Durability, light weight, a high strength-to-weight ratio, long laying lengths, watertight joints and smooth interior surfaces are characteristics which make PVC pipe an attractive alternative for use in sewer systems. Disadvantages include possible chemical instability due to long-term exposure to sunlight, excessive pipe deflection under trench loadings when installed improperly or subjected to high temperature wastes, and brittleness when exposed to very cold temperatures.

b. PVC sewer pipe is available in diameters 4-inch through 24-inch, and in laying lengths of 10 to 20 feet. Pipe dimensions comply with the standard dimension ratio (SDR) system, which means that mechanical properties are constant without regard to pipe sizes. Joints are integral bell and spigot type, and utilize elastomeric gaskets.

c. PVC pipe must be installed to provide continuous passive lateral soil support along the conduit. Manufacturer's design manuals, in addition to the Unibell PPA Handbook of PVC Pipe, will be utilized in checking deflection, backfilling, and trench loads. Allowable pipe deflections will be indicated in the project specifications.

6-8. Acrylonitrile-butadiene-styrene plastic.

a. Acrylonitrile-butadiene-styrene (ABS) composite pipe consists of two concentric thermoplastic tubes integrally connected across the annulus by a truss-like bracing. The annular void space is filled with portland cement concrete, or other suitable material, to form a bond between the inner and outer tubes. ABS composite pipe is termed a "semi-rigid" pipe because it resists deflection better than most other plastics. The pipe is light in weight and resists attack by acids, alkalies, and biological growths. ABS composite pipe is available in diameters 8-inch to 15-inch, and in one laying length of 12.5 feet. ABS pipe is joined by either socket type molded fittings, which are solvent fused to the pipe, or by means of mechanical seal couplings utilizing O-ring gaskets. The solvent welded joints minimize the possibility of poor joint construction, and greatly reduce ground water infiltration. Manufacturer's design and installation manuals will be used for selecting pipe embedment, backfill and compaction requirements.

b. ABS solid wall plastic pipe is manufactured from the same compounds as composite pipe, however, the pipe wall is of one solid material. The pipe is available in diameters 3-inch through 12-inch

and has the same jointing as composite pipe. However, it does not match the stiffness of composite pipe.

6-9. Reinforced plastic mortar.

a. Reinforced plastic mortar pipe (RPMP) is composed of a siliceous sand aggregate reinforced with glass fibers, and embedded in a thermosetting polyester resin. RPMP is ideally suited for large diameter applications, and performs extremely well in resisting pipe wall deflection and internal/external corrosion. The unique fiberglass/resin construction provides optimum protection against attack from a wide range of chemically aggressive environments including hydrogen sulfide and other sewer gases, most natural soils, salt, and brackish water and galvanic or electrolytic reactions. No special coatings or cathodic protection are required. Even though RPMP is officially designated a flexible conduit, its structural integrity is such that for most installations, the trench preparation and backfill requirements are considerably less than with other flexible conduits, and even some rigid ones. Its other advantages include light weight and a smooth, glass-like interior surface.

b. RPMP is available in diameters 8-inch through 144-inch, and in laying lengths of 10, 20, and 40 feet. Joints are bell and spigot type utilizing O-ring gaskets. Manufacturer's design and installation manuals will be used for guidance in selecting appropriate trench and backfilling procedures.